National Forest Inventory - British Columbia

Data Collection Procedures for Inaccessible Grid Locations

Prepared by
Ministry of Sustainable Resource Management
Terrestrial Information Branch
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For further information about the Resources Information Standards Committee, please access the RISC website at: http://srmwww.gov.bc.ca/risc/.

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1. Introduction

Objectives

The objectives of this document are:

- To define circumstances that cause a sample location to be considered inaccessible.
- To highlight the significance of the effect of incomplete data due to inaccessible sample locations in the analysis of National Forest Inventory (NFI) data.
- To highlight the potential effect of missing information on the assessment of change in timber attributes over time.
- To provide a process through which the bias associated with missing information due to inaccessible sample location problems can be ameliorated.

Background

The Canadian National Forest Inventory (NFI) has a plot location design based on a 20 x 20 km grid system. In British Columbia, the 20 x 20 km grid system results in approximately 2,400 grid intersections. Of the 2,400 grid points, approximately 1,200 fall on either forested areas or areas that have the potential to be forested, such as recently harvested land. These forested or potentially forested locations are the population of interest to be sampled and a total of 268 sample locations are presently identified as ground sampling grid points.

Forested grid locations were randomly selected to be visited on the ground and permanent sample locations are being established. These points are to be remeasured or monitored at regular intervals over time. Some of the targeted forested sample locations are expected to be inaccessible. Potential reasons for inaccessibility include steep cliffs, private property where the owner denies access, or other dangers.

This document describes a procedure that will facilitate the collection of alternative data that will be equivalent to what would be obtained from the original targeted location.

Causes of Inaccessible Samples in NFI

In British Columbia, the likelihood of encountering inaccessible samples in forest inventory is considerable. Potential reasons for inaccessibility of the grid point locations include:

- **Dangerous or inaccessible plot locations** in areas that contain steep cliffs and unstable slopes.
- **Locations inaccessible due to difficult access,** such as rock bluffs, gullies, avalanche tracks or rock slides that make access to the location by regular field crews not possible.
- **Locations inaccessible due to excessive distance or lack of reasonable access**. For example, if it is impossible to reasonably get the crews to the location by all access means, including helicopters.
- **Locations where access is denied on private land.**

- **Locations inaccessible due to permanent danger to the crew.** (Locations temporarily inaccessible due to dangerous wildlife may be accessible later when the animal moves to a new location.)

Determining Alternative Sample Locations

In most cases, inaccessible samples represent unique vegetation communities. If information from these communities is not captured, the statistics computed from the incomplete sample grid will be biased.

The matching process is not perfect and will not entirely eliminate the possibility of bias, but it brings us closer to the unbiased outcome. The key objective of this exercise is to reduce bias associated with a sample that does not represent critical components of the target population.

Random substitution from the list of polygons in the population does not address the issue of missing information from the unique conditions at the inaccessible grid locations. Therefore random substitution is **NOT** acceptable.

Once a NFI site has been matched, it is assumed that future changes at the matched site will be typical of what is happening at the original site. There is no interest in comparing data from the original site to that at the matched site — if that were possible, matching would not be necessary in the first place.

Constraints to Acquiring Alternative Locations

Addressing inaccessible sample locations in a grid-based system has several limitations, including:

- The long distance between grid points makes it difficult to find matching grid points with identical characteristics.
- Selecting points between grid intersections breaks the systematic placement of the sample points.
- Current photography to assist in matching the inaccessible location may not be available.
- If the matched location is not located on the grid system, a separate sampling frame must be created to find a match.

It is important to ensure that the correct procedure is followed to obtain data equivalent to that which would be obtained from the inaccessible grid point. A rigorous matching process provides a sample data set that is representative of all possible conditions in the land base being inventoried.

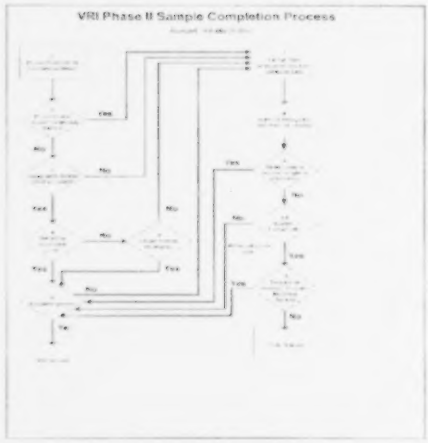

Figure 1. Decision tree chart for evaluating and substituting inaccessible samples.

2. Detailed Procedures for Matching Inaccessible Samples

Figure 1 shows a decision tree for deciding what to do when a sample is determined to be inaccessible. The matching procedures for collecting data are based on the decision tree.

Step 1: Sample Selection

The NFI Project Manager will select a list of samples for field measurement.

Step 2: Photo Review of Sample Locations

The Project Manager performs a preliminary assessment, using air photographs, of all sample locations.

If the photo review indicates a sample location that would be obviously dangerous and inaccessible, proceed to Step 7 and fill out a Non-Completion form and a Compass (CP) card.

If a number of samples are determined to be potentially inaccessible, the Project Manager may initiate a helicopter reconnaissance of all identified samples to verify the photo assessments.

Step 3: Samples are Assessed for Reasonable Access

If the photo review indicates a sample has no reasonable access point, proceed to Step 7 and fill out a Non-Completion form and Compass (CP) card.

Step 4: Samples are Assessed for Land Tenure

If the tenure review by the Project Manager indicates that the sample location is on private land, provincial parkland, or other alienated lands, a concerted effort must be made to obtain access permission (Step 5).

Step 5: Obtain Permission (or Document Denial) for Private Land Samples

Obtain from the Land Registry Office the name, phone number, and address of the registered land owner. Contact the owner by phone and follow up with a letter or, if appropriate or necessary, with a personal visit.

Sufficient advance notice should be given the land owner or governing agency to allow for review and approval of the land access request.

If access permission is obtained, proceed to Step 6.

If access permission is denied, proceed to Step 7 and fill out a Non-Completion form and Compass (CP) card. Pertinent information regarding denied access or permission must be recorded on project file for the adjustment reporting process.

Step 6: Field Crew Establishes the Sample

A qualified field crew must establish all field samples. The field crew must visit and establish the Integrated Plot Centre (IPC) as the plot will be remeasured in the future.

In the field, some samples initially thought to be accessible may turn out to be inaccessible because of rock bluffs, steep gullies, or unstable slopes that prevent access to the sample. In this case, proceed to Step 7 and fill out a Non-Completion form and Compass (CP) card.

Step 7: Documenting Inaccessible Samples

The group of all samples that cannot be measured initially constitutes the "population" of inaccessible samples. The Project Manager or project team will, by this time, have explored all viable options to complete the samples (such as returning to complete the data collection after a temporary hazard is removed). For each of the uncompleted samples, the Project Manager or field crew must complete a Non-Completion form and a Compass (CP) card and add it to the original sample package.

Step 8: Requesting a Matching Sample

The Project Manager or field crew submits the entire package to a qualified reviewer with a request for a matching sample location.

Documentation Package

The submission package must clearly document the reasons why the sample was considered inaccessible. This information package will be prepared by the field crew and will usually be reviewed by the Project Manager at the Terrestrial Information Branch. The package submitted should include:

- A large-scale map clearly showing the location of the polygon being sampled and the Integrated Plot Centre (IPC).
- A forest cover map highlighting the polygon being sampled, with the IPC located and marked.
- A photo pair with the sample IPC clearly and accurately located and marked.
- A comment on the form shown in Figure 2 indicating whether an air or ground reconnaissance had been done to determine accessibility. This would eliminate any discrepancy about the level of accessibility.

Step 9: Assessment by Qualified Reviewer

The reviewer conducts a review of the sample in question. If the reviewer disagrees with the initial assessment that the sample is inaccessible due to excessive distance or lack of a reasonable access point, the request for a matching sample will be rejected, and the crew will be advised to establish the original sample. The reviewer may assign a different crew to collect data from such a location.

Step 10: Temporary or Permanent Inaccessibility

If the cause of inaccessibility is not permanent (such as a wildlife encounter), the crew will return to establish the original sample after the threat is gone.

If the cause is permanent (including steep, unstable slopes, cliffs, or no reasonable access points), proceed to Step 11 and obtain a matching sample.

Step 11: Matching the NFI Sample Location

The reviewer will provide a matching sample location and alternate matching locations for the field sampling crew if possible. If no suitable matching site can be found the sample will be dropped. The sample matching process is explained in the following section.

Approaches to Matching the NFI Grid Locations

The primary objective of the matching process in the NFI is to select a substitute sampling site that is suspected to have minimal bias. Approaches to the "matching" process, in the order of priority are:

1. **Find another grid point among the 2,400 NFI grid points that fall in British Columbia that has similar characteristics to the inaccessible one.**

   This method is unlikely to produce desirable results. Matching the conditions at the grid point becomes more difficult as you move farther from the original grid intersection.

2. **Search for a match along the grid lines running north, east, south, or west from the inaccessible grid intersection.**

   This is a simple exercise to locate alternative grid points at 100-m intervals in cardinal directions on ortho photos (somewhat more difficult on standard photos, but achievable). This methodology is repeatable and can be documented, and the intent to sample the original grid location is maintained.

3. **Search within a 20 x 20 km area, with the centre at the inaccessible grid point, to find a match.**

   This is an easy exercise to define the area of the search. This should provide sufficient area to conduct a reasonable search.

4. **Search within a 40 x 40 km area with the centre at the inaccessible grid point to find a match.**

   This approach has less focus than Approach 3 and would require more time to accomplish. It is also unlikely that an identical (or nearly identical) site will be found when the distance is extended beyond 20 km from the original inaccessible location. The 40 x 40 km area is defined by the eight grid points adjacent to the inaccessible grid location. In most cases, the actual distance from the original grid location will be less than 20 km.

   If the number of inaccessible samples is small, the overall bias is believed to be small. The effect on the current and future usefulness of the data set would most likely not be overly affected by this minimal bias. This approach simplifies sample selection and documentation and reduces current and future cost.

   However, since sample statistics will be reported by ecozone, dropping a few samples in a zone may represent a substantial proportion of the sample size allocated to that zone. In

such cases, the bias associated with inaccessible sample locations would not be acceptable. Tracking change over time in such situations may provide misleading results.

Some have suggested the idea of creating a separate stratum of inaccessible samples. In reality this is not practical, unless a subsample of the inaccessible locations can be visited on the ground to collect data representing that stratum. If some data collection is not possible for the stratum, the inventory data for the inventory unit as a whole is incomplete.

Even when data collection is possible, it may be difficult to accurately define the proportion of inaccessible area to which the sample statistics are applicable. For the NFI, the sample sizes in the ecozones vary from 10 to 143 grid locations. With such small sample sizes, it is difficult to determine with any degree of accuracy what proportion a single inaccessible location represents in the population. If 1 of 10 locations is inaccessible, it does not necessarily mean that 10% of the population is inaccessible. A much larger sample is required to confirm that this proportion is representative.

Criteria for Selecting Matching NFI Grid Locations

The following criteria should be used for finding a substitute for an inaccessible grid intersection:

1. **Same ecozone**

   The forested samples were chosen randomly from throughout British Columbia. It is essential that the match for an inaccessible location has the same ecozone as the matching location, because reporting may be completed at the ecozone level.

2. **Similar biogeoclimatic ecosystem classification (BEC) zone and variant**

   Although, the sample was not distributed by BEC zone, it is desirable to match inaccessible locations by BEC zone. This will increase the usefulness of the data if post-stratification by BEC becomes necessary.

3. **Similar inventory forest cover description**

   The leading species, height, and age of the stand in which the inaccessible grid point is located should be similar to the stand description at the potential matching location. Sites where the second species at the original location is the same as the leading species at the matched location may be acceptable.

4. **Similar stems (or volume) per hectare**

   The stand density and estimated volume per hectare for the two locations should match.

5. **Similar slope, aspect, and elevation**

   The slope, aspect, and elevation of the matching location should be as close as possible to the inaccessible location. Wide tolerance in the variation of this criterion should be considered.

Procedures for Matching NFI Grid Locations

The following procedure should be used to find matching location(s) for an inaccessible NFI grid point:

1. Obtain existing air photography associated with the inaccessible NFI grid location. Use the 2 x 2-km photos if they are available.
2. Supplement the photos with additional local photography if it is available.
3. Examine the inaccessible NFI grid location on a stereo pair.
4. Record a description of the tree species, density of trees, tree height and estimated age of trees, and crown closure at the inaccessible NFI location in Column 2 of the Inaccessible Sample Form (Figure 2). This description should be of the selected NFI grid location, not the map polygon stand description where the grid point is situated.
5. Use the description to search among the 2,400 NFI grid points that fall in British Columbia for substitute locations with the same location description as the inaccessible grid point.
6. The search should spread along grid lines running north, east, south, or west from the original NFI grid intersection.
7. If a match is not found, continue the search on the area surrounding the inaccessible grid location. The search should first concentrate on the 20 x 20 km area centred on the inaccessible NFI grid point, then, if unsuccessful, expand to 40 x 40 km.
8. If a match is not found after steps 5 to 7, then terminate the search and provide documentation of reasons the search failed.
9. When a matched site is found, fill in Column 3 "Description of the Matched Site" (Figure 2). The descriptions allow you to compare what is at the inaccessible location and what is at the matched site, based on photo interpretation. If suitable matching attributes are found, mark the area best matching the original grid point directly onto the photo. If access to the matching sample is potentially not possible, provide alternatives numbered in order of priority.
10. File the form as part of the regular NFI data collection documentation.

Return the original sample package, the completed Inaccessible Sample form (Figure 2), and the marked document photos identifying the matched location to the field crew to have the sample established.

Ground Data Collection

After the matched site has been identified, the new site should be visited on the ground to collect measurements on a number of attributes following the same sampling procedures as for regular NFI grid locations. The only difference is that the sample type is identified as "M" under Character 2 of "Plot Type" on all the field cards.

Detailed ground data collection procedures are provided in the "National Forest Inventory - British Columbia, Change Monitoring Procedures for Provincial and National Reporting" manual, which is available online at:

http://srmwww.gov.bc.ca/tib/veginv/publications.htm

Reporting the Data from Matched NFI Grid Locations

The UTM co-ordinates of the matched location should be well documented to ensure the relocation of the sample location for remeasurement. For reporting purposes, however, the match should be identified as being located at the real (original inaccessible[1]) grid point. Therefore, the UTM co-ordinates of the matched location should be recorded on Field Card 3, but the original design UTM co-ordinates should recorded under the "Comments" on the same card.

Inaccessible Sample #: 27 **Project** _____

(one substitute sample location per form)

Attribute	Estimates at Inaccessible Location	Description of Matched Site	Comments
BEC	IDF	IDF	
Species composition	Fd 60, Pl 20, At 20	Fd 50, Pl 45, At 5	Less aspen on general site than original sample location
Basal area	25	30	
Tree height	23	25	Tree heights more variable on matched site
Estimated age	130	120	Ground call age near matched site but no data near original location available
Crown closure	75	80	
Estimated slope	110%	90%	
Aspect	SW	SSW	
Elevation	1150	1100	
Other			

Figure 2. Inaccessible Sample Form for recording a description of an inaccessible NFI sample location and the matched site.

[1] This is a suggestion. Some planners may choose to report the actual data source location. That is acceptable.

NFI GROUND SAMPLE - RECORD OF PLOT NON-COMPLETION

(to be filled out for any plot that cannot be established)

Sample #	27
Map sheet	92 H 078
Polygon #	568

Crew	John Smith
Date	July 12, 2003
Project	TFL 234

Why the plot cannot be established (check all applicable boxes)

- [x] Access to plot is too dangerous
- [ ] Plot would be located in an unsafe area
- [ ] Plot would be located in river or lake
- [ ] Permission denied to access private land
- [ ] Other, specify:

Detailed comments:

Figure 3. Record of Plot Non-Completion form to document the reason(s) for failing to reach a targeted sample site.